Art. XVI.—*Experiments on the Dhak Gond, a natural Exudation of the Butea Frondosa.* *By* Mr. E. Solly, Jun.

This substance, which although it differs in some particulars from the Kino which is found in the shops, yet as it agrees in its most important properties with what has so long been described under that name, it is most convenient to call it *Butea Kino.*

It is of a brilliant ruby red colour, transparent, and very brittle. It consists principally of small round tears, and other fragments, which from their form appear to have been detached from the lesser branches of the tree. When it has been kept for some time, it becomes opaque and dark coloured; this however may be prevented, according to Dr. Roxburgh, by preserving it in well-closed bottles. I have examined two specimens of this substance, one brought over by Mr. Beckett, and the other received from Bombay. There was considerable difference between the two, but from their properties it was evident that they had been originally similar. The following description is equally applicable to both specimens, except where it is otherwise stated.

When exposed to heat, the Butea kino swells up, emits fumes which are partially inflammable, and then ignites; if after that it is removed from the source of heat, it continues to glow like tinder, until nearly wholly consumed, a very small portion of a white ash only remaining. Ten grains of the kino, carefully selected as to purity, were ignited in a covered platinum vessel, and retained at a red heat until all the carbonaceous matters were burnt; there then remained 0·45 grains of white ash, a very small portion of which was soluble in acids with effervescence, the remainder consisted principally of silica and alumina. The specimens of Butea kino were far from being in a state of purity, being mingled with small fragments of wood, bark, and also with earthy impurities: these were evidently derived from the mode of collection, which most probably consisted in gathering from the ground under the trees the fragments of the natural exudations which had fallen from them. The impurities in the specimen brought over by Mr. Beckett varied from 12 to 25 per cent., of which from 4 to 6 were earthy; that from Bombay contained in general far more impurities.

It swells and slowly dissolves in the mouth, having a pure, strong astringent taste, like the finer kinds of catechu. It has no smell.

In cold water it swells, and slowly imparts to it its fine red colour; after some time only the outer portions of the kino remain, which by exposure to the air had become dark coloured and almost insoluble in water, whilst the whole of the interior and unaltered kino is dissolved. These insoluble portions consist principally of difficultly soluble extractive. A sufficient quantity of boiling water dissolves the whole, and on slowly evaporating the solution, the difficultly soluble extractive separates in tough red films[1]. The quantity of this extractive of course varies considerably in the two specimens, and influences their solubility. The Bombay variety is far less easily soluble in water, and clear solutions are much more difficult to obtain when made with hot water; they are very apt to become turbid, and, if strong, gelatinise on cooling; and if the water contained any saline or earthy substances, this was almost certain to take place. From these circumstances it is rendered very probable that the sample from Bombay had been exposed to the air for a longer time than the other; it was most likely collected at another period of the year, after having remained exposed to the air, damp, and light, for some time. From the description of the properties of the exudation when fresh, and only just become hard, as given by Dr. Roxburgh, in 17—, it is evident that it should be only collected at that period, as it is then far more applicable to useful purposes, whether in medicine or the arts, than after exposure to the air, &c. Both alcohol and pyroligneous spirit dissolve a considerable portion of the Butea kino, but far less than water. Ether dissolves but little, and remains colourless; when a portion of ether is agitated with a strong aqueous solution it soon becomes thick, and, on evaporation, yields a considerable portion of tannin.

A small quantity of persulphate of iron changes the colour of the aqueous solution to a dirty green; a rather larger quantity occasions a copious green precipitate.

A series of experiments were made on the effects of various reagents on solutions of this kino, with a view to ascertain which were the best precipitates of the red colour, either for dyeing, or as a pigment.

Solutions of most acids, and acid salts, changed the colours to a light orange, and for the most part occasioned copious precipitates; they were nearly all of a dirty yellow or orange colour.

When a few drops of a strong solution of caustic potassa were added to the aqueous solution of the kino, the colour was immediately altered, and very much improved, becoming of the most

[1] This also takes place with the kino of the shops.

splendid crimson; when however a little more of the solution of potassa was added, the colour rapidly became gray, and a copious precipitate fell. It very quickly became dark reddish gray, and nearly the whole of the colour was destroyed. Caustic soda and ammonia likewise improved the colour in the same way. When acids were added to solutions thus precipitated, so as just to neutralise the alkali, some of the precipitate redissolved, and the rest became orange. Carbonates of potassa and soda both very much deepened the colour of the solution; it was however not to be compared in beauty of colour with the solution obtained by the addition of a small quantity of caustic potassa, and had a slight brown tinge. In general most saline solutions occasioned precipitates which were either pink, gray, or colours between the two. Acetate of lead, as well as several other metallic solutions, precipitated the whole of the colouring matter. The precipitate obtained by adding a solution of alum either to a neutral solution, or to one containing a small quantity of alkali, was of a dirty pink colour. When gelatinous or recently precipitated alumina was agitated with any of the highly coloured solutions, it soon abstracted all the colouring matter, but the lake so formed was, like those formed by precipitation, of a dingy colour. The precipitates formed by metallic solutions were of very variable hues, but in no case were the colours so obtained decided or brilliant. Attempts were likewise made to fix the colour in the fibre of cotton, silk, wool, &c., in various ways, and with different mordants; the colours were all imperfect, dingy, and variable in colour, but they were very permanent. This agrees with the results obtained by Dr. Roxburgh, but as his experiments were made on the fresh substance, they were under more favourable circumstances. The cause why these colours cannot be well employed is, that the red colouring matter is so intimately combined with the tannin and gum, that whenever the one is precipitated, it carries down the other also, and hence, when we endeavour to precipitate the tannin alone, the red colour or extractive is always precipitated with it: this, as will presently appear, is in some cases a great inconvenience.

A solution of gelatine produced, in aqueous solutions of the Butea kino, an abundant precipitate of tanno-gelatine, which always contained a portion of colouring matter: this varied very considerably between the two portions of kino, that from Bombay containing by far the most: when a solution of the kino from Mr. Beckett, either in cold water, or still better in alcohol, was precipitated, the tanno-gelatine contained very little colour. The solution, after the separation of the precipitate, contained gum, extractive, gallic acid,

and minute portions of other matters: the quantity of gallic acid was very various, but in no case did it appear to exist in any considerable proportion.

It was difficult to ascertain the exact per centage of tannin, as it varied very much in different specimens submitted to examination. I have therefore repeated the experiments on several portions, and shall now give the mean of some of the best results obtained.

One hundred parts of the rough kino from Mr. Beckett were dried for 6 hours at a temperature of about 130° Fahrenheit: they lost 13·23 parts of water. Much of this water was derived from the wood, bark, and impurities, for the pure substance when separated was far less hygrometric. The kino thus dried was digested in water kept nearly at the boiling point, until a strong solution was made; this was then poured off, and the process repeated with fresh portions of water, until all the matters soluble in that fluid had been thus removed. The residual matters, consisting only of impurities, weighed 17 parts. The solutions were then rapidly evaporated to a considerable degree of concentration, during which 3·5 parts of difficultly soluble extractive fell down. It was necessary to complete this evaporation as rapidly as possible, because if the hot solution was long exposed to the air, it became much darker coloured and was somewhat altered in properties. The solution was then precipitated by a strong solution of gelatine, of which 28·3 parts were employed. The precipitate, when collected, washed, and carefully dried, weighed 79 parts; by subtracting from this the weight of the gelatine employed, the proportion of matter precipitable by animal jelly is ascertained to be 50·7. This was of course principally tannin, but it contained a portion of coloured extractive which gave to it a dark colour, varying in depth with the circumstances under which the solution was made, &c. The remainder of the solution, after the separation of the tannin, was evaporated; it contained gum, a small quantity of gallic acid, extractive, and minute traces of saline and earthy matters, weighing in all 15 parts. The Bombay kino contained less tannin and rather more gallic acid and extractive, and by long continued boiling with free access of air, the composition of either kind might be easily modified. If this substance were to be employed in the arts, it would be very probably most convenient to obtain it as an extract, unless by so doing it became much darker in colour. By dissolving the tannin by cold water, I have obtained extracts in which the per centage of tannin was as high as 75·, and sometimes even higher; but these extracts were made under the most favourable circumstances, being prepared

with rapidity and the least possible exposure to the air. It would be utterly impossible to manufacture the extract in the large way in this manner, if the causes above mentioned do not prevent it, but it might very probably be advantageous to prepare the kino of the Butea as an extract, as the cost of freight would be therefore less.

From the large per centage of tannin which this substance contains, as indicated by the above experiments, and from its probable cheapness, it promises to be of considerable value in the arts, and especially in that of tanning leather. As a substitute for the astringent substance now in use, its adoption in many cases from convenience or economy are self-evident, and require no comments; but in the art of tanning leather so many points require to be considered, that it is necessary to say a few words on that subject. On putting a piece of pelt or prepared skin into a strong solution, it soon absorbed a considerable quantity of tannin, but, at the same time, became of a rather dark colour; this is an unfortunate quality, because, as the consumers of leather judge of its quality in part from its colour, the tanners do not like employing anything which deepens the colour too much. The colour taken up by the leather of course varied with the solution employed, a cold solution of the kino from Mr. Beckett giving a much lighter coloured leather than a hot-made solution; that from Bombay gave a darker colour, and the solution was very subject to gelatinise and become turbid; this of course would be a great inconvenience. The leather tanned with this kino was very hard and rather brittle, but it was tanned with considerable rapidity. These results were obtained on small pieces of thin skin, and I do not anticipate that it will answer at all for tanning such skins: its richness in tannin, however, promises well for tanning thick hides; and the results of experiments on its application to this process now in progress will be communicated on a future occasion.